D15

HIGH-RESOLUTION GAMMA RAY SPECTROSCOPY EXPERIMENT ON HEAO 3

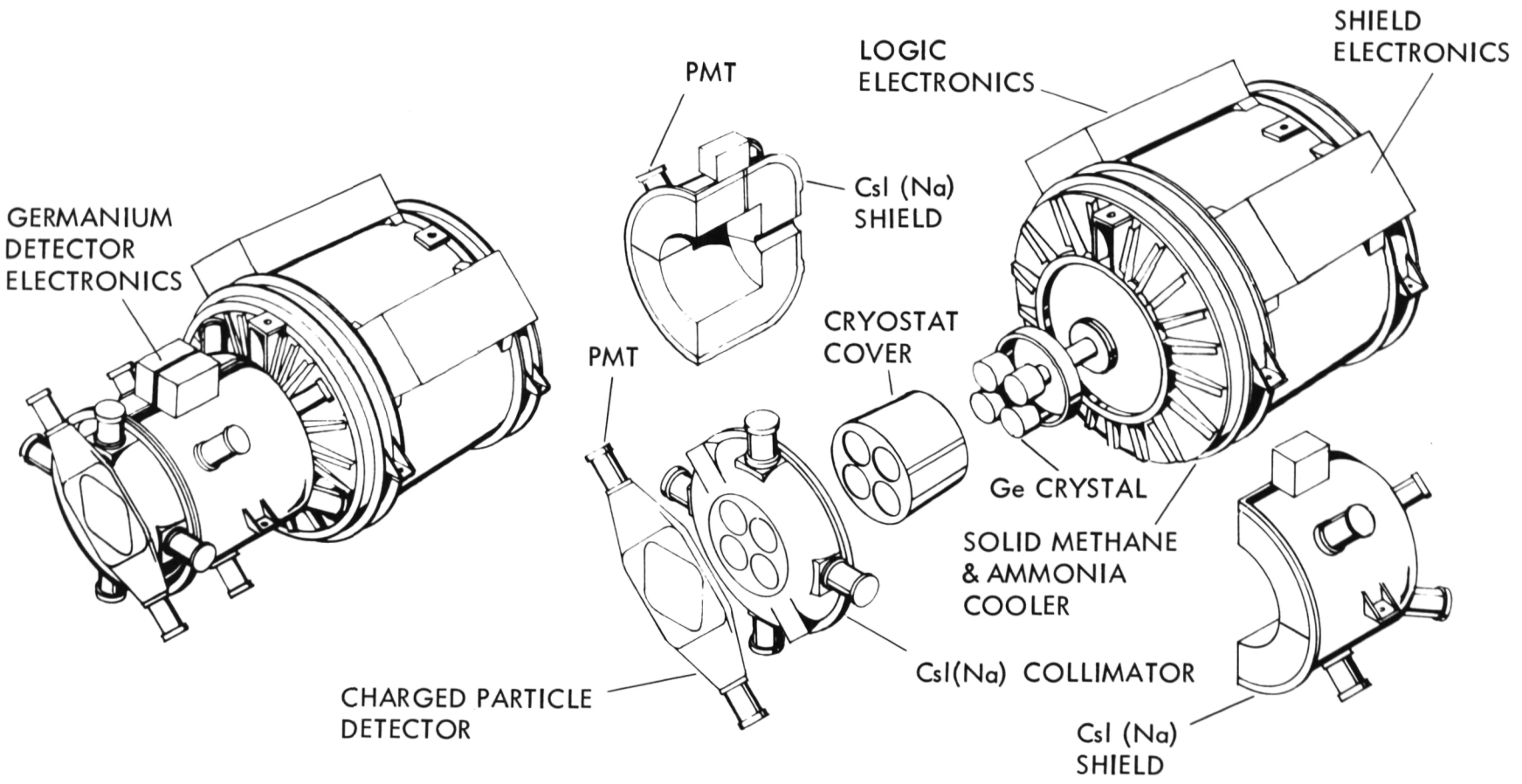
Existence of a 0.511-MeV electron-positron annihilation line from the galactic center region has been confirmed by the JPL high-resolution gamma ray spectrometer aboard the Third High-Energy Astronomy Observatory (HEAO 3). The instrument, whose prime objective was to perform an all-sky survey of gamma ray line emissions in the 0.045- to 10-MeV energy range, produced other significant results in 8-1/2 months until the prime sensor's life ended prematurely with depletion of the cryogen required to cool its germanium detectors. However, all scientific objectives were achieved and the cesium iodide shield detectors continue to detect gamma ray bursts and solar flares.

The HEAO 3 scanning mission allowed the instrument (employing a 30-degree field of view) to cover the entire celestial sphere within 6 months of launch into Earth orbit on September 20, 1979.

During the first 8 months of the mission, the spacecraft was maneuvered on two occasions -- for 2 weeks in the fall of 1979 and 18 days in the spring of 1980 -- to scan the galactic plane. In addition to detecting the electron-positron annihilation line, the spectrometer detected the continuous gamma ray emissions from the Crab Nebula and Cygnus region. Numerous solar flares and one gamma ray burst were also observed. A flare on November 9, 1979, indicated a strong 2.2-MeV deuterium line. Although such a line had been measured by others using scintillation detectors, this was the first measurement of the feature with high spectral and temporal resolution. A gamma ray burst lasting about 18 seconds occurred on November 16, 1979. Preliminary results of the event show possible spectral structures, although the data are limited by counting rate statistics.

Overall results of the observations will lead to a better understanding of the processes of high-energy interactions occurring in various astrophysical environments in the universe.

Figure (*opposite page*): Components of the high resolution gamma ray spectrometer used aboard the HEAO 3 are shown. The spectrometer includes a cluster of four coaxial high purity germanium (Ge) detectors surrounded by pieces of cesium iodide (CsI) scintillator operating in active anticoincidence with the central detectors and defining a 30-degree field of view.


GERMANIUM
DETECTOR
ELECTRONICS
PMT
CsI (Na)
SHIELD
LOGIC
ELECTRONICS
SHIELD
ELECTRONICS
PMT
CRYOSTAT
COVER
Ge CRYSTAL
SOLID METHANE
& AMMONIA
COOLER
CsI(Na) COLLIMATOR
CHARGED PARTICLE
DETECTOR
CsI (Na)
SHIELD